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ABSTRACT:

## PATENT SPECIFICATION

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DRAWINGS ATTACHED

1 204 541

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## (54) METHOD OF MAKING FIBRE REINFORCED PLASTER ARTICLES

- (71) We, NATIONAL RESEARCH DEVELOPMENT CORPORATION, a British Corporation established by Statute of Kingsgate House, 66—74, Victoria Street, London, S.W.1., do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—
- 5 This invention relates to a method of making fibre-reinforced plastic articles.
- 10 According to one aspect of the invention there is provided a method of making a plaster article comprising mixing glass fibres with an aqueous slurry of gypsum plaster to produce a mixture in which the fibres are well dispersed, delivering the mixture to a mould either during or after mixing, and extracting water from the mixture to lower the water/plaster ratio to a value approaching but not below the minimum required to hydrate the plaster.
- 15 According to another aspect of the invention a method of making a plaster article comprises impregnating a glass fibre mat with an aqueous slurry of gypsum plaster, transferring the impregnated mat to a mould and extracting water from the impregnated mate to lower the water/plaster ratio to a value approaching but not below the minimum required to hydrate the plaster.
- 20 Two or more impregnated glass fibre mats may be superimposed and consolidated in the mould.
- 25 The extracted water may be extracted from the mixture or the impregnated mat by suction, centrifugal action or pressure, or by any suitable combination of these means.
- 30 The invention can be used for making glass fibre reinforced gypsum plaster boards, mouldings or extrusions for constructional use, for example, in the manufacture of wall, floor, ceiling or roof structures, doors or cabinets. Such articles can be arranged to have good fireproof characteristics and high strength, particularly flexural strength and impact strength.
- 35 The initial aqueous slurry of gypsum plaster, possessing a relatively high water/plaster ratio, ensures that the glass fibres are well dispersed therein and/or well wetted to ensure a good bond between the fibres and the plaster. The initial water/plaster ratio may be at least fifty parts by weight of water to a hundred parts by weight of plaster.
- 40 For the best results in terms of the strength of the article, the water/plaster ratio after extraction of the water should be such that there is just enough water to hydrate the plaster. For example, for a hemihydrate gypsum plaster mix the lower water plaster ratio should be of the order of 18% which will result in a plaster having a compressive dry strength of up to 10,000 p.s.i.
- 45 To achieve these best results the extraction of excess water is preferably at least in part effected by pressing the article in the mould. Pressure of the order of 400 lb. p.s.i. is preferably employed. Using pressure to extract excess water has the added advantage that the article being moulded is consolidated.
- 50 While, if desired for specific purposes, the glass fibres may be orientated in one direction or another, for general purposes a random distribution gives good results. The glass fibre used is conveniently low-alkali boro-silicate (E glass) which is readily commercially available either in the form of roving, chopped strand, or mat. Good results have been obtained using fibres one to two inches in length. The amount of fibre employed is largely a matter of choice depending upon the strength required. It has been found, however, that if more than about 15% by weight of fibres is added the composite tends to become spongy and cannot be adequately consolidated.
- 55 Plaster boards incorporating 10% by weight of glass fibre have been found to have bending strengths (modulus of rupture) of 15,000

lb. p.s.i. and impact strengths of 400 in lb. p.s.i.

One embodiment of the present invention is further described below with reference to the diagrammatic drawing accompanying the Provisional Specification, in which:—

Figure 1 shows apparatus for impregnating a glass fibre mat with a fluid plaster mix and for removing some of the water from the mix, and

Figure 2 shows a filter press for removing more water from the impregnated mat.

Referring first to Figure 1, a vessel 1 contains a gypsum plaster mix 2 with a relatively high water/plaster ratio. A suction box 3 connected by an outlet tube 4 to a vacuum pump (not shown) has an open bottom located just below the surface of the mix 2. A grill 5 extends across the open bottom.

A glass fibre mat 6 extends through the mix 2 below the suction box 3. In operation, the mix 2 impregnates the mat 6 and some water is removed from the impregnating mix by suction. In a continuous production process, the mat 6 may be drawn through the mix 2 on a permeable belt, or the suction

box 3 may be replaced by a rotating perforated drum.

The filter press shown in Figure 2 includes upper and lower platens 7 with grooves 8 in their opposed surfaces covered by filters 9. In use, the impregnated mat is located between the platens 7 which are then forced towards one another to apply pressure to the mat such that water is expelled from the mat and escapes through the filters 9 and grooves 8.

The following is an example of the type of material that can be produced by such a process.

A mat of chopped E glass rovings, weighing  $1\frac{1}{2}$  oz. per sq. ft. was impregnated on the suction box with a hemihydrate gypsum plaster mix having a water/plaster ratio of 1.0 by weight. Three layers of this impregnated mat were consolidated on the filter press to a water/plaster ratio of 0.23 i.e. 5 per cent in excess of the amount required to hydrate the plaster.

The properties of this board, in the dry state, were as follows:—

	Thickness	$\frac{1}{2}$ inch
	Weight	2.9 lb./sq.ft.
	Glass fibre content	10% of total weight
	Flexural strength	8,700 p.s.i.
55	Impact strength (Izod), greater than	200 in lb./in. <sup>2</sup>

This material can be compared with asbestos cement, which it somewhat resembles in its method of manufacture and in its possible production in the form of sheets, pipes, moulded products and extrusions.

In comparison with asbestos cement, it has the disadvantage that in common with all gypsum plaster products it can only be used where it is protected from the weather, since gypsum is slightly soluble in water. However, although restricted to internal use it has many compensating advantages, namely:

In manufacture, there is very rapid development of strength and therefore no need for stockpiling.

In use, the flexural strength is more than double that of asbestos cement, and the impact strength is greater by an order of magnitude. Asbestos cement shatters on impact, but this material suffers only slight localised damage. It is suitable for any type of decorative treatment or surface coating, and has very good fire-resistance, since the gypsum plaster contains a considerable proportion of combined water.

In order to make a plaster article in which glass fibres are dispersed rather than provided

in the form of a mat, although they may be mixed with the initial aqueous slurry of gypsum plaster in any suitable manner, for example, by stirring or agitating, a particularly useful method of mixing is simultaneously to spray the slurry and chopped rovings over the surface of a mould. When using this mixing technique the mould is preferably in the form of a vacuum bed comprising for example a perforated steel plate covered with a special high wet-strength paper, the excess water being extracted by suction from below. By this means it is possible to produce curved or folded shapes, or honeycomb structures which will allow the material to be used for folded-plate or stressed skin constructions.

A suction of 12 lb./sq.in. has been found adequate to remove the excess water though to achieve the most efficient dewatering and also better compaction of the composite it is necessary to subject the same to pressure of about 400 lb./sq.in.

Details of a number of glass fibre reinforced composites made by simultaneously spraying the fibres and an aqueous slurry on a mould as described above, and their properties, are set out in the table below:—

Sample	Plaster	E glass fibre			Water/Binder		Density g/ml.	Flexural strength lb/in <sup>2</sup>	Impact strength in.lb/in <sup>2</sup>	Tensile strength lb/in <sup>2</sup>
		Length (in)	% by wt. of		Ratio (by weight)					
			Demoulded panel	Dry panel	Slurry	Demoulded panel				
1	β Hemihydrate	2	6.5	7.4	0.49	0.34	1.45	3,630	171	1,650
2	(Plaster of	2	9.7	11.0	0.49	0.29	1.45	2,750	251	
3	Paris)	2	9.7	11.5	0.49	0.30	1.45	3,610	206	1,560
4		2	12.1	14.5	0.52	0.30	1.39	3,120	275	1,750
5		1	10.8	12.4	0.52	0.35	1.60	4,500	210	2,380
6		1½	8.4	10.1	0.49	0.30	1.48	3,880	133	
7		2	11.4	12.5	0.52	0.18	1.70	4,260	232	2,060
8	α-Hemihydrate	2	6.8	7.1	0.40	0.17	1.88	4,570	167	2,000
9	(autoclaved)	2	10.6	10.8	0.40	0.16	1.74	4,680	261	2,370
10	plaster	2	12.3	12.6	0.40	0.18	1.77	4,490	282	2,450

NOTE: Sample No. 7 was pressed (at 400 lb./in.<sup>2</sup>) after forming on the suction mould.

#### WHAT WE CLAIM IS:—

1. A method of making a plaster article comprising mixing glass fibres with an aqueous slurry of gypsum plaster to produce a mixture in which the fibres are well dispersed, delivering the mixture to a mould either during or after mixing, and extracting water from the mixture to lower the water/plaster ratio to a value approaching but not below the minimum required to hydrate the plaster.
2. A method of making a plaster article comprising impregnating a glass fibre mat

- with an aqueous slurry of gypsum plaster, transferring the impregnated mat to a mould and extracting water from the impregnated mat to lower the water/plaster ratio to a value approaching the minimum required to hydrate the plaster.
3. A method as claimed in Claim 2, in which two or more glass fibre mats are impregnated, superimposed and consolidated in the mould.
4. A method as claimed in Claim 1, 2 or 3 in which water is at least in part extracted

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by applying pressure to the mixture or the impregnated material, as the case may be, in the mould.

5. A method as claimed in Claim 5 in which a pressure of the order of 400 lb./sq.in. is applied.

6. A method as claimed in any one of the preceding claims in which the extracted water is at least initially extracted by applying suction to the mixture or the impregnated mat, as the case may be, in the mould.

7. A method as claimed in any one of the preceding claims in which the aqueous slurry of gypsum plaster comprises at least fifty parts by weight of water to a hundred parts by weight of plaster.

8. A method as claimed in any one of the preceding claims in which the glass fibre comprises low-alkali boro-silicate (E glass).

9. A method as claimed in Claim 1 or any

of Claims 3—8, as dependant thereon, in which the glass fibre is in the form of roving or chopped strand.

10. A method as claimed in claim 9 in which the glass fibres are one to two inches in length.

11. A method as claimed in claim 9 or 10 in which up to 15% by weight of glass fibres is mixed with the aqueous slurry.

12. A method of making a high strength plaster article substantially as herein described in the example, or with reference to the drawing accompanying the Provisional Specification, or the accompanying table.

13. A plaster article or composite produced by the method claimed in any one of the preceding claims.

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COMPLETE SPECIFICATION

1 SHEET

*This drawing is a reproduction of  
the Original on a reduced scale*

FIG.1.

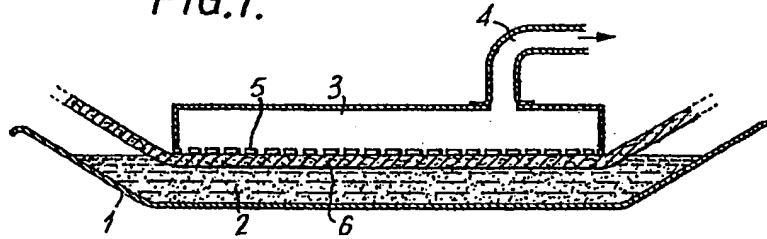


FIG.2.

